Aroostook River Data Report
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Introduction

The Aroostook River Basin is the largest sub basin of the St John River lying almost entirely within the state of Maine. It has a drainage area of 2353 square miles at the international border of U.S. and Canada. The river segment of interest on the Aroostook begins in Masardis (River Mile 69) and flows to Washburn (RM 37), Presque Isle (RM 28), Caribou (RM 14), Fort Fairfield (RM 3) and eventually the international border (RM 0). In Canada, after an additional 4.6 miles, the Aroostook joins with the St John River.

The purpose of the data collection effort is to develop an updated water quality model of the Aroostook River. A model calibration data set was collected in 1987. A water quality model was setup on the USEPA supported model, QUAL2EU, but an additional verification data set to complete the model was never collected. The two low flow data sets collected in the summer of 2001 will be used to re-calibrate and verify the water quality model. The model is then typically used to predict worst case (low flow, high water temperature) water chemistry of such parameters as dissolved oxygen, algae, or nutrients. Regulatory measures on both point and non-point source pollutant inputs may be necessary if the model predictions for dissolved oxygen are lower than statutory requirements.

The data collection effort involved stakeholder participation from the towns of Washburn, Presque Isle, Fort Fairfield; McCain Foods; the Aroostook Band of MicMacs; and personnel from MDEP, Augusta; and the Northern Maine Regional Office of DEP in Presque Isle.

Point source discharges and their permitted licensed flows are as follows: Ashland (0.3 mgd), Washburn (0.28 mgd), Presque Isle (2.3 mgd), McCains (2.5 mgd), Caribou (1.41 mgd), Loring (2.5 mgd), and Fort Fairfield (0.6 mgd). The influence upon downstream water quality from the first two point sources is minor due to their low flow volume. The last four point sources have more flow volume and result in a noticeable difference in downstream water quality. Hence throughout the report, references to major point source discharges includes Presque Isle, McCain Foods, Caribou, and Fort Fairfield. Non-point source (NPS) inputs related to agricultural and forested land uses are also possible relevant pollution sources to the Aroostook watershed.

Technical Design of Study

Details of the technical design of the Aroostook River study are explained in the Aroostook River Work Plan (May 2000). Some of the highlights are repeated here for convenience. The sampling that was undertaken on the Aroostook River last summer involved two independent three-day low flow events for re-calibration of the water quality model. In addition, tributary sampling was undertaken during dry weather and wet weather conditions to assist in model non-point source (NPS) pollution estimates and give relative assessments of the likely subwatershed with NPS issues.

The low-flow data sets were collected in the summer of 2001 during the weeks of August 14-16 and August 28-30. The low flow three-day sampling events involved sampling the Aroostook River from Tuesday to Thursday at 13 locations and 6 tributary locations (table 1). Dissolved oxygen and temperature were sampled twice per day; in the early AM and early to mid afternoon. In addition phosphorus series (TP, PO4-P); nitrogen series (TN, NH3-N, NO2-N, NO3-N), chlorophyll a, ultimate BOD, TSS, and VSS were collected in the AM for laboratory analysis. Composite samples for the seven point source discharges were collected one day prior to the ambient samples (Monday to Wednesday) and sampled for N-series, P-series, chlorophyll a, TSS / VSS, and UBOD / BOD5. Each treatment plant tracks their own flow as part of discharge monitoring requirements. This data will be used to help compute pollutant load inputs for each point source. Flow was gaged on the Aroostook River below Grimes Mills and at major tributaries (Little Madawaska River, Presque Isle Stream, and Caribou Stream) at least one time during each three-day low flow survey. One set of cross sectional (transect) data was also collected prior to the three day low flow surveys. In addition, transect data was collected in the Caribou impoundment during the second low-flow survey at 12 locations.

The second component of the study involved sampling 16 tributary sites (table 2) a total of five independent times for DO, temperature, P-series, and TSS / VSS.; three of which were sampled under wet weather conditions and two under dry weather conditions. The wet weather tributary data sets were collected on the following dates of 2001: May 15, May 31 and June 3, and July 16. The dry weather tributary data sets were collected on August 13 and August 27

of 2001, both of which occurred one day prior to the three-day low flow data collection effort.

Table 1 Aroostook River 3-Day Low Flow Sampling Locations

Sta Code	Location	DO Temp	P-Series	N-Series	Chl a	BODu	TSS VSS
AR0	Rte 11 Bridge, Ashland	2/day	1/day	1/day	1/day	1/day	1/day
AR0a	Ashland below (Near Rte 11)	2/day	1/day	1/day	1/day	1/day	1/day
AR1	River Rd Bridge in Washburn	2/day	1/day	1/day	1/day	1/day	1/day
AR1a	Crouseville	2/day	1/day	1/day	1/day	1/day	1/day
AR2	1/2 mile upriver from Rte 1 bridge in Presque Isle (near Rte 164)	2/day	1/day	1/day	1/day	1/day	1/day
AR3	Maysville	2/day	1/day	1/day	1/day	1/day	1/day
AR4	McGraw	2/day	1/day	1/day	1/day	1/day	1/day
AR5	Above Caribou Dam	2/day	1/day	1/day	1/day	1/day	1/day
AR6	Adjacent Grimes Mill Rd,	2/day	1/day	1/day	1/day	1/day	1/day
AR7	Goodwin	2/day	1/day	1/day	1/day	1/day	1/day
AR8	Stevensville	2/day	1/day	1/day	1/day	1/day	1/day
AR9	Rte 1A Bridge Fort Fairfield	2/day	1/day	1/day	1/day	1/day	1/day
AR10	USA / Canada border	2/day	1/day	1/day	1/day	1/day	1/day
Presque Isle Stream							
PIS0	Park St Bridge	2/day	1/day	1/day	1/day	1/day	1/day
PIS8	Parson St Connector	2/day	1/day	1/day	1/day	1/day	1/day
PIS13	Railroad Trestle	2/day	1/day	1/day	1/day	1/day	1/day
Little Madawaska River							
LM1	Bowles Rd	2/day	1/day	1/day	1/day	1/day	1/day
LM2	Grimes Rd Grimes Mills	2/day	1/day	1/day	1/day	1/day	1/day
Caribou Stream							
CS	Near confluence with Aroostook	2/day	1/day	1/day	1/day	1/day	1/day
Effluents							
Station	Treatment Facility		P-Series	N-Series	Chl a	BODu	TSS
ASH	Ashland		24 hr composite sample				
WAS	Washburn						
PRI	Presque Isle						
MCC	McCain Foods						
CAR	Caribou						
LOR	Loring						
FTF	Fort Fairfield						

Table 2 Tributary Sample Location for Non-Point Source Assessment

Station Code	Location	Drainage Area mi^2	Wet Sampling Protocol	DO Temp	P-Series	TSS/VSS
t-SCS	St Croix Stream, Masardis	238	day after	**1/day**		
t-SPS	Squa Pan Stream, Masardis	5.7	same day			
t-MR	Machias River, Ashland	330	day after			
t-LMR	Little Machias R Ashland	63	day after			
t-AB	Alder Brook, Ashland	10.3	same day			
t-GAB	Gardner Brook, Wade	14.1	same day			
t-SB	Salmon Brook, Washburn	55	day after			
t-CB	Clayton Brook, Washburn	10	same day			
t-NBP	N Br Presque Isle Str, Maple	32	same day			
t-MB	Merritt Brook, Presque Isle	N/A small	same day			
t-HB	Hardwood Brook, Maysville	6.5	same day			
t-PB	Prestile Brook, Caribou	5.5	same day			
T-CS	Caribou Stream, Caribou	50	day after			
t-OB	Otter Brook, Caribou	18.5	same day			
t-GRB	Gray Brook, Fort Fairfield	6.2	same day			
t-HHB	Hockenhull Brook, Fort Fairf.	15.6	same day			

Hydrologic Data
Flow

The low flow data sets are initiated by the requirement of achieving a satisfactory low flow condition in the Aroostook River. The flows which initiate sampling are referred to as "trigger flows." Two trigger flows were targeted for the Aroostook study; the first of which was the satisfactory low flow trigger or 80% flow duration, and the second of which was the ideal low flow trigger or 90% flow duration. The USGS gage at Washburn was examined typically on Friday to determine whether or not sampling should be initiated beginning the Monday of the following week. The first and second trigger flows at the USGS gage in Washburn are 560 cfs and 390 cfs, respectively.

In a low flow survey, a steady river flow is as important as low flow conditions. The lack of runoff two weeks prior to the low flow surveys should also be targeted. Significant runoff during the sampling effort which result in greater than 50% flow deviations should be boundaries defining when sampling should cease due to excessive runoff.

The flows for both low flow surveys were well under the second 390 cfs trigger, and hence easily exceed expectations for an ideal low flow survey (figure 1). The average flow at Washburn for the first low flow survey (Aug 14-16) was 145 cfs and river flow was generally declining over the three day period. The average flow at Washburn for the second low flow survey was 127 cfs but flow rose from 107 to 133 cfs from August 27 to August 30 due to a precipitation events experienced from August 27-29. However, the 24% rise in river flow still is under the 50% flow deviation set in the work plan as suitable conditions for a steady flow condition. The flow on some of the tributaries, in particular, Presque Isle Stream was noticeably higher due to this runoff event. The precipitation reported by the Presque Isle Sewer District during this period (1.4 inches) was higher than other parts of the watershed (.4 to .5 inches) indicating that there was locally more rainfall in Presque Isle. However no sampling constraints were placed upon tributaries. For the most part there was no runoff two weeks prior to each survey, except for small precipitation events from August 20 to 22 (0.2 to 0.3 inches) in which flow at Washburn increased from 138 to 151 cfs over a two day period (8/20-22).

It should also be realized that both data sets were sampled at conditions close to 7-day 10 year low flow (7Q10). The first low flow event was 11% higher than 7Q10 and the second 19% lower than 7Q10 (figure 2). The 7Q10 flow is the design condition used for making model prediction runs for regulatory purposes. Hence when all factors relating to suitable river flow are considered collectively, conditions were extremely good for collecting low-flow model calibration data sets.

The wet weather event sampling targeted storm sizes greater than 1 inch of total rainfall preferably distributed somewhat evenly throughout the watershed. Obtaining this condition is difficult, since rainfall is ordinarily not distributed evenly in the summer, and, in particular, in a large watershed such as the Aroostook. Precipitation reported on the discharge monitoring reports from three treatment facilities (Ashland, Presque Isle, McCain Foods) is compared to period when sampling occurred on the Aroostook or its tributaries (figure 3).

These data indicate that during the first wet weather sampling event (May 15) precipitation was about 0.4 to 0.65 inches 48 hours prior to sampling, falling below the goal of the 1 inch storm. The Aroostook River flow was minimally affected during this wet weather event (figure 1).

The second wet weather sampling event was undertaken during the beginning of several consecutive days of storms, which resulted in a seven-fold increase in the Aroostook River flow (figure 1). Due to the uneven distribution of rainfall, the sampling occurred on two separate days; May 31 for the lower watershed, and June 3 for the upper watershed. The rainfall totals 48 hours prior to sampling were around 1.2 inches for the lower watershed (May 29-31) and 0.75 inches for the upper watershed (June 1-3). The upper watershed also received an additional 0.6 inches of rain from May 29-31 (figure 3). It is concluded that the second wet weather event generally met the goal of capturing a 1 inch storm.

The third wet weather event was sampled on July 16 during what was originally intended to be a dry weather sampling event the day prior to a three-day low flow event. Rainfall distribution throughout the watershed was rather uneven during this precipitation event. Rainfall reported by the three treatment facilities varied from 0.4 to 1.6 inches (figure 3). The four-fold increase in flow recorded by the gage at Washburn (figure 1) indicates that significant runoff occurred following this precipitation event. The large amount of runoff was partially due to the wet antecedent moisture conditions, since in the two weeks prior to this event, frequent rainfall events occurred (figure 3).

In summary, the first wet weather event fell below expectations, but the second and third events were sampled during satisfactory runoff conditions.

River Transects

River transects were collected on August 22 at most sampling locations and four additional transects in-between Ashland and Presque Isle. Eleven additional transects were collected in the Caribou Dam impoundment during the second low flow survey. All of the transect data were collected at river flow conditions slightly under 7Q10 and provide valuable information of river hydraulic conditions at low flow. River widths were measured using GPS equipment. In wadeable locations, depth was measured every seven feet along a transect width using a surveying rod. The sites in the Caribou dam impoundment are not wadeable. Here depths were measured using a continuous recording depth fathometer that was attached to a boat. In all, 24 transects were measured and are summarized below (table 3). The transects are also plotted in chart format (Appendix 5).

Table 3 Summary of Transect Data

Sta Code	Location	Area (ft^2)	Width (ft)	Ave Depth (ft)
AR0	Rte 11 Bridge, Ashland	217	128	1.70
AR0a	Ashland below (Near Rte 11)	228	148	1.54
AR0b	Sheridan East	214	165	1.30
AR0c	Upstream Gardner Brook	189	165	1.14
AR0d	Below Donnelly Island	160	400	0.40
AR1	River Rd Washburn	280	171	1.64
AR1a	Crouseville	523	475	1.10
AR1b	Railroad Trestle below Crouseville	186	215	0.87
AR2	0.5 Miles Up from Rte 1, Presque Isle	364	212	1.72
AR3	Maysville	196	131	1.50
AR3-1	Caribou Dam Impoundment	1744	436	4
AR3-2	Caribou Dam Impoundment	1944	352	5.52
AR3-3	Caribou Dam Impoundment	2249	446	5.04
AR3-4	Caribou Dam Impoundment	2657	423	6.28
AR4	Caribou Dam Impoundment McGraw	3079	477	6.45
AR4-1	Caribou Dam Impoundment Powerlines	3829	459	8.34
AR4-2	Caribou Dam Impoundment	4334	487	8.90
AR4-3	Caribou Dam Impoundment	4138	417	9.92
AR4-4	Caribou Dam Impoundment	5280	461	11.45
AR4-5	Caribou Dam Impoundment	6514	590	11.04
AR4-6	Caribou Dm. Impoundment Boat Launch	7031	550	12.78
AR5	100’ Above Caribou Dam	7670	568	13.5
AR6	Adjacent Grimes Rd	280	167	1.68
AR7	Goodwin	258	218	1.18
AR8	Stevensville	227	395	0.57

Ambient Chemical Data
Temperature and Dissolved Oxygen

Temperature and dissolved oxygen (DO) were sampled twice daily in each three day low flow survey; in the early morning and early to mid afternoon. In addition, continuous data was collected utilizing sondes above the Caribou dam (survey 1) and at the Goodwin site (survey 2). The average morning temperatures in the Aroostook for the first low flow survey (Aug 14-16) were around 20 ^{o}C in the shallower flowing areas and 22 to 24 ^{o}C in impoundments (figure 4). The afternoon temperatures in the Aroostook in the first survey were around 24 to 26 ^{o}C (figure 4). The average morning temperatures in the Aroostook for the second low flow survey (Aug 28-30) were around 18 ^{o}C in the shallower flowing areas and 19 to 20 ^{o}C in impoundments (figure 4). The afternoon temperatures in the Aroostook in the second survey were around 20 to 22 ^{o}C (figure 4).

When the diurnal fluctuations of temperature are examined, there is generally a trend of greater fluctuation in the shallower segments and less fluctuation in impoundments (figure 5). The average diurnal temperature fluctuation from both surveys combined was as large as 5 ^{o}C in flowing segments and as small as 1 ^{o}C in impoundments. The largest diurnal temperature fluctuation of 6.5 ^{o}C occurred on Presque Isle Stream below the treatment plant outfall. This is probably due to both the shallowness of this stream and the large amounts of urbanized land adjacent to both stream banks.

The dissolved oxygen data is characterized by large diurnal fluctuations due to the significant growths of both bottom-attached (benthic) and floating algae (phytoplankton). There is similarly a trend of greater fluctuation in the shallower flowing sections and less fluctuation in impoundments (figure 6). There is also a trend of less fluctuation above the significant point source discharges. In the segments above major point source discharges (first five upstream locations and background tributary) average diurnal DO fluctuations are generally around 1 to 2 ppm. Below major point source discharges, average diurnal DO fluctuations range from 5 to 9 ppm in the shallower flowing segments and 1 to 4 ppm in impoundments.

When the daily minimum DO is compared to statutory criteria, it can be observed that all locations on the Aroostook met or exceeded minimum requirements (figure 7). However it should be mentioned that even though satisfactory worst case conditions of high water temperature and low river flow occurred, point source discharges were collectively at less than 4% of their licensed BOD load. When the tributary sites are examined, it can be observed that the two sites below the PISD outfall on Presque Isle Stream were 1 to 2 ppm below minimum criteria and a third (background) site marginally met or was slightly under criteria.

The daily maximum DO sampled in the afternoon were all supersaturated (> 100% saturation). The readings are generally much higher below major point source discharges and in the shallower flowing sections as compared to impoundments. In the segments above major point source discharges, daily maximum DO is around 100% of saturation. Below major point source discharges, daily maximum DO ranges from 150% to 240% of saturation in the shallower flowing segments and 120% to 150% of saturation in impoundments.

The data sonde continuous monitoring compares reasonably well to instantaneous measurements utilizing dissolved oxygen meters (figures 8a, 8b) with the exception of the August 28 afternoon meter reading of 19.1 ppm for DO at Goodwin compared to the sonde reading of 15.2 ppm. The data sonde shows a similar trend observed by the meter readings of larger diurnal fluctuation of DO and temperature at Goodwin when compared to the site above the Caribou dam.

Nutrients

Total phosphorus (TP) and orthophosphorus (OPO4) were sampled on the morning run of each sampling day. TP shows an increasing trend in the downstream direction of the Aroostook River (figure 9). TP concentrations were generally under 10 ppb in the first five stations on the Aroostook, which are upstream of all major point source discharges. TP concentrations average about 20 ppb below the Presque Isle and McCain Food discharges and increase to a maximum of 70 to 80 ppb below the Caribou and Loring

discharges. TP concentrations decrease to 20 to 60 ppb in the final three locations before the USA/Canada border in the Tinker Dam impoundment.

On the tributary locations, TP concentrations average about 10 ppb on the two Little Madawaska River stations and Caribou Stream. On Presque Isle Stream, TP concentrations range from 20 to 40 ppb above the Presque Isle discharge and range from 30 to 120 ppb below the discharge.

Total nitrogen (TN) concentrations are generally around 0.3 ppm in the first five stations on the Aroostook, which are upstream of all major point source discharges (figure 10). There is a large increase in TN below Presque Isle, which is due primarily to the McCain Foods discharge. The majority of the nitrogen increase observed here is nitrate nitrogen, and hence most of the ammonia nitrogen has already been oxidized within McCain's treatment plant before being discharged to the Aroostook River. TN concentrations average about 2 ppm at the McGraw sampling location in the Caribou dam impoundment. TN concentrations show a declining trend from McGraw to the USA/Canada border where concentrations range from 0.6 to 1 ppm.

On the tributary locations, TN concentrations range from about 0.5 to 1 ppm except at the two locations on Presque Isle Stream below the treatment plant where concentrations are sometimes as high as 1.5 to 2 ppm.

Chlorophyll a and Secchi Depth

Samples were collected in the morning and analyzed for chlorophyll a (CHLA) to determine levels of phytoplankton in the water column. CHLA levels show an increasing trend in the downstream direction and at location below point source discharges (figure 11). Levels are at about 2 ppb above major point source discharges and increase to a range of 10 to 21 ppb in the first low flow survey in the Caribou dam impoundment. These levels are indicative of a eutrophic state. In the second low flow survey CHLA levels in the Caribou dam impoundment range from 5 to 9 ppb. CHLA levels below the Caribou dam and into the Tinker dam impoundment are usually in-between 5 to 10 ppb but sometime exceed 10 ppb and similarly show a eutrophic state. CHLA levels on tributary locations are usually under 5 ppb.

Although not qualitatively sampled, large levels of benthic algae were observed in the Aroostook River, in particular, below the Caribou dam to the Tinker dam impoundment. The benthic algae are also evident in Presque Isle Stream below the treatment plant discharge.

Secchi depth measurements were made at impoundment locations. In the Caribou dam impoundment secchi depth showed little variability for both low flow surveys and averaged around 2.5 meters. In the Tinker dam impoundment secchi depth averaged 1.6 meters and 2.2 meters in the first and second low flow surveys, respectively.

Ultimate BOD

Samples were collected for ultimate BOD analysis in the morning. Ultimate BOD samples are run in the laboratory for a period of 60 days or more and DO depletion observed for several readings. A least square regression model is run to determine the most appropriate fit of a curve to the observed BOD Vs time plot. The final ultimate BOD and the laboratory (bottle) BOD decay rate are obtained from the regression equation. The raw BOD data and the results of the regression are tabulated in a spreadsheet format in the appendix. The nitrogenous component of the BOD is obtained from a difference of initial and final nitrate nitrogen times a stoichiometric factor of 4.33. The carbonaceous component of BOD is obtained from a difference of total BOD and nitrogenous BOD.

The total ultimate BOD of the Aroostook River was typically around 3 to 5 ppm at the sample locations upstream of all major point source discharges and at the Little Madawaska River and Caribou Stream locations (figure 12). These values are typical of areas with low to moderate pollution. TBOD at Aroostook River locations below point source discharge were typically around 5 to 8 ppm showing moderate levels of pollution. TBOD on the on Presque Isle Stream above the treatment plant location

ranged from 6 to 11 ppm and are much higher than what would ordinarily be expected for a background location. TBOD levels on Presque Isle Stream below the treatment plant generally maintained this range.The laboratory bottle BOD decay rate averaged about 0.06 /day for both low flow surveys. The bottle decay rate is ordinarily considered a lower boundary of the actual river BOD decay rate assigned for modeling purposes.

Effluent Chemical Data

Seven point source discharges were collected as composite samples in the days prior to the ambient sampling. When the effluent data are plotted comparatively as input loads, it can be observed that McCain Foods, Caribou, and Fort Fairfield are the three largest point source inputs of pollutant loads, and Presque Isle, Loring, Ashland, and Washburn comparatively have a much smaller input (figures 13-15).

When effluent BOD5 loads are compared to allowable licensed amounts, all plants were discharging under 6% of their licensed BOD5 during both low flow surveys except Presque Isle which was at 10% and 17% of their licensed BOD5 in survey 1 and 2, respectively (figure 16). Presque Isle is a plant that performs at advanced treatment levels and has licensed BOD limits that are much lower than a conventional secondary plant. Collectively, the seven treatment plants were at 3.9% and 3.7% of their licensed BOD5 loads in low flow survey 1 and 2, respectively.

The effluent CBODu/BOD5 ratio is an important consideration when undertaking the model prediction design runs. The model predicts the amount of ultimate BOD that fits in the river, while still maintaining minimum DO criteria. However the amount of allowable BOD is licensed as BOD5. The CBODu/ BOD5 factor is the conversion factor needed to convert model results to licensed amounts. The individual plots for each effluent are plotted in the appendix and summarized below in tabular form.

Table 4 Effluent CBODu to BOD5 Ratio

Effluent	Ultimate CBOD / BOD5
Ashland	2.91
Washburn	10.34
Presque Isle	3.52
McCain Foods	3.52
Caribou	2.26
Loring	3.64
Fort Fairfield	1.80

Wet and Dry Weather Tributary Sampling

The wet weather and dry weather tributary samples are collectively plotted for TSS (figure 17) and TP Figure 18. There is usually an expected trend of lower dry weather TSS and TP compared to wet weather TSS and TP, except at the North Branch of Presque Isle Stream location in Mapleton, where both dry weather and wet weather TP and TSS are high. There is also the expected trend of lower TSS and TP in sampling locations of the upper watershed as compare to sampling locations in the lower watershed, due to a larger portion of the upper watershed with forested cover. The following table summarizes the potential of non-point source pollution on each tributary (based upon TSS and TP sampling).

Table 5 – Non-Point Source Pollution Potential of Tributaries

Tributary	NPS Pollution Potential
St Croix Stream, Masardis	Low
Squa Pan Stream	Low
Machias River, Ashland	Low
Little Machias River, Ashland	Low
Alder Brook, Ashland	Moderate
Gardner Brook, Wade	Low
Salmon Brook, Washburn	Moderate
Clayton Brook, Washburn	Moderate
North Branch Presque Isle Stream, Mapleton	High
Merritt Brook, Presque Isle	High
Hardwood Brook, Maysville	High
Prestile Brook, Caribou	High
Caribou Stream, Caribou	High
Otter Brook, Caribou	Moderate
Gray Brook Fort Fairfield	High
Hockenhull Brook, Fort Fairfield	High

Quality Control

Proper quality control was followed to assure that all of the data that will be collected is good data. Dissolved oxygen meters were calibrated initially before sampling and checked periodically throughout the day. In addition, the meters were cross checked both prior to sampling and after completion of sampling with adjacent sampling teams to assure the readings from one portion of the river to another are consistent and accurate.

In the QC check of dissolved oxygen meters amongst adjacent teams, river water is collected in a bucket and after calibration of the meters, the dissolved oxygen and temperature are recorded. The dissolved oxygen readings should agree to within 0.3 ppm to be considered acceptable and temperatures to within 2 ^{o}C. An examination of the field cross checks indicates that these goals were usually achieved (figure 19).

The WRI Laboratory in Orono was used for a majority of the laboratory analysis. . The WRI laboratory does not analyze for BOD. The NMRO of DEP's laboratory did the analysis of all ambient BOD. The HETL in Augusta did the analysis for all effluent BOD samples.

Duplicate sampling (as recommended in the work plan) was undertaken at one river location, one tributary location, and one effluent for each day of sampling. This results in an overall duplicate coverage of 12% per day. The results of the duplicate sampling indicate satisfactory results occurred. Of the 101 duplicate samples that were analyzed, a total of 78% of the duplicates were within 10% of sample results and 88% were within 20% of sample results (table 6). The duplicate results also indicate that dissolved oxygen and temperature are the most reliable measurements followed by nitrate nitrogen, total nitrogen, and total phosphorus. Total BOD and chlorophyll a were less reliable with the latter being the least reliable. Ammonia nitrogen and nitrite nitrogen were not analyzed as duplicates due to the fact that the results of theses parameters were often either very low or below the detection limits of analysis.

Table 6 Duplicate Samples Deviation

Parameter	Number Samples	Average Deviation	% with Deviation < 10%	% with Deviation < 20%
Ambient				
Dissolved Oxygen	12	1%	100%	100%
Temperature	12	0.6%	100%	100%
Total Phosphorus	11	12.6%	54%	73%
Total Nitrogen	11	1.7%	100%	100%
Total BOD	11	13.6%	54%	73%
Chlorophyll a	11	28.9%	54%	63%
Nitrate Nitrogen	11	1.5%	100%	100%
Effluent				
Total Phosphorus	5	6.1%	80%	100%
Total Nitrogen	5	22.6%	80%	80%
Total BOD	3	33%	33%	66%
Chlorophyll a	4	14.6%	25%	75%
Nitrate Nitrogen	5	3.7%	80%	100%
Total	101		78%	88%

A1 – Effluent CBODU/BOD5 Plots

A2- Water Quality Data

A3- BOD Analysis

A4- Flow Data

A5- Transects

A6 – Map of Sample Locations

A7 – Responses to Comments

Presque Isle Sewer District

Appendix 2 – Water Quality Data

1. Comment: The boldface entries for TP indicating data from PISD's facility on 8/28 is in error, since they did not provide any TP information on that day.
   Response: This data is actually data provided by the intensive survey and should not be boldface. This correction will be made in the final data report.

2. Comment: The PO4-P value of 5.1 ppb for station PIS13 on 8/28/01 is inconsistent with PISD's sampling results (35 ppb) at that location for the same date and also inconsistent with the result obtained in the intensive survey at PIS8 on 8/28/01.
   Response: DEP agrees that the 5.1 ppb result for PO4-P is inconsistent with other sampling results for that day. However phosphorus data is often variable, in particular, below a wastewater treatment plant and there is no reason to reject this data. This data point will be relied on less in the modeling effort.

McCain Foods (Woodard and Curran)

Comment: Page 1, para. 4 – McCain flow rate in error, no reference made to whether flows cited for treatment plants are actual flows or licensed flows.
Response: Text will be added in the Introduction section to explain that the flows cited are licensed flows and the McCains flow will be corrected.

Comment: Page 4 – Hydrologic Data – Absence of time-of travel data will make velocity determinations difficult. Include old USGS time of flow study in report.
Response: There is adequate transect data to determine velocity, which can be directly calculated at each transect by dividing flow by cross sectional area. An old time of flow dye study undertaken by DEP will provide additional information. The data report is limited to data collected in 2001. Information pertaining to the dye study could be summarized in the modeling report.

Comment: Page 8, Para. 3 – Diurnal DO also affected by diurnal temperature changes.
Response: This may be true, but the data report was not intended to interpret the data in detail. The statement that diurnal DO changes are primarily due to algae is correct.

Comment: Page 8 – Use of word major to define point sources ambiguous.
Response: The following text will be added to the Introduction section:
"The influence upon downstream water quality from the first two point sources is minor due to their low flow volume. The last four point sources have more flow volume and result in a noticeable difference in downstream water quality. Hence throughout the report, references to major point source discharges includes Presque Isle, McCain Foods, Caribou, and Fort Fairfield."

Comment: The data report provides no review of ammonia or organic nitrogen. There is not sufficient ammonia to reflect the NBOD estimates in the BOD test. The total nitrogen observed below McCain's are due to nitrate nitrogen.
Response: Once again it should be realized that the data report was not intended to interpret the data in detail. Nutrient assessments were limited to total nitrogen and phosphorus and do not include the various components of total nutrients. Ammonia nitrogen should not be used as a check on available nitrogen for NBOD estimates in the BOD test. TKN, which includes both organic nitrogen and ammonia, should be used, since over a period of 60 days, hydrolosis of organic nitrogen to ammonia should occur. A check of the total oxidizable nitrogen available (TKN) should be multiplied by 4.33 and this product should not exceed the reported NBOD value. All NBOD values passed this check.

The following text will be added to the Nutrients section of the data report:

"The majority of the nitrogen increase observed here is nitrate nitrogen, and hence most of the ammonia nitrogen has already been oxidized within McCain's treatment plant before being discharged to the Aroostook River."

Comment: Were chlorophyll a values corrected for dead algae cells?
Response: Yes. There wasn't much difference between corrected and uncorrected chlorophyll a.

Comment: Page 20 – Why did the North Branch of Presque Isle Stream have high TSS and TP in both the dry and wet weather sampling.
Response: The intent of the data report is to report the trends and not necessarily interpret that data in detail and find reasons for trends, except in situations with an obvious answer.

Comment: Appendix 2 – DO % saturation value (19.8%) reported for AR5 on 7/3 for the Single Days Surveys table appears to be in error.
Response: Agreed. This will be corrected.

Comment: Appendix 4 Flow Rates – Some flow rates are different from the ones listed on USGS's website.
Response: The flow rates are provisional data subject to change. The flow reported may have been reported last summer on USGS's website. This information will be rechecked and updated and will be flagged as provisional data. The text within the Flow section of the report will also be updated as necessary.